John Fieldhouse

The Scarlet Runner

2032

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DISCOVERY PROGRAMMES

The Scarlet Runner

This programme has the following test record:

First tested in 10 schools in five localities
(nine Junior, one Secondary)
Further tested with 18 children
in three Junior schools
Error rate on published programme
with representative population=4·5%
Parallel test to Test 3, given between two and four
weeks later, revealed a retention figure
of 66%
Gain, pretest to post test=60%

2032

DISCOVERY PROGRAMMES
General Editor: John Leedham, M.Ed.

2032

The Scarlet Runner

John Fieldhouse

Alderman Richard Hallam Junior School, Leicester

Illustrated by Mary Grierson

2032 (5106)

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Titles in this series will include

THE AIR WE BREATHE by John Leedham
A FIRST BOOK OF SETS
A SECOND BOOK OF SETS } by John Clarke
THE GEOMETRY OF THE POINT AND LINE
by Cyril Harries
AREA AND VOLUME by John Leedham and D. V. Parker
DON'T SMOKE! by R. W. Kind and John Leedham
THE WORLD OF NUMBER by Norman Beard
A FIRST BOOK OF FRACTIONS
A SECOND BOOK OF FRACTIONS } by John Clarke
UNDERSTANDING NUMBER BASE by John Clarke

Printed in Great Britain by Lowe & Brydone (Printers) Ltd.

Introducing Discovery Programmes

Discovery Programmes are programmed books developed by practising teachers. They seek to introduce fresh material, or to put forward traditional material in a new way; they are intended to be a real adjunct to the work of the teacher. All have been carefully tested and have proved their worth under classroom conditions. The texts require a reading age of 10·4 or above; no previous knowledge of their subjects is needed.

Discovery Programmes are the fruit of experiments in programmed learning carried out by a group of teachers in the Leicestershire Education Authority. Our programmes were tested and retested in many schools in the locality, and the editor would like to express his appreciation of the help provided by the Director and Committee of the Leicestershire Education Authority.

"Programmed Learning is one of the most important new tools teachers have at their disposal. We are only at the beginning of exploring its full potential and I certainly will not attempt to guess how far it will take us. The important thing is to realise that it is a tool to be used by the teacher and not a substitute for him. A programme has the merit of infinite patience and it gives its undivided attention to the child who is using it. If it is a good one, it is subtle in providing the right doses of motivation."

Stewart C. Mason, M.A.
Director of Education, Leicestershire

To the Teacher

This programme is for children aged about 10·5 plus, with the reading ability normally associated with this age. No previous knowledge of the subject is assumed.

The programme directs the pupil to a living subject, indicating points of interest likely to be valuable in a later study of growth, adaptation, and reproduction. It is best worked from May to September, the normal period of growth of the scarlet runner. Germination of the seed, however, may be studied at almost any time of the year, and the programme is so designed that observation of the plant itself, though very desirable, is not absolutely necessary at the time of working.

For working the programme, a small notebook in which to write responses and make drawings is needed. A piece of paper or card, as wide and as long as this page, is used to mask the answers. For the experiments, the following materials are required:

> five scarlet runner seeds, two glass jars, blotting paper, sawdust or cotton wool, two bean sticks.

It is an advantage to have space in a garden, if possible.

To the Pupil

If you wish to learn in the quickest, most enjoyable, and most satisfying way, play this game according to the rules. Here they are.

1 THINK carefully about each frame.
2 WRITE your answer to any question asked.
3 THEN and only then, move down your mask, or turn over the page, to see the correct answer.
4 COMPARE it with your own answer.
5 CORRECT your answer if it is wrong.
If your answer is right, mark it with a tick, and pass on to the next frame. If it is not,
6 THINK again to find out why you have not put the right answer and go back over earlier frames if necessary.

To the Pupil

This is a programme. This is how it works:

1 Cut a piece of cardboard or paper just long enough and wide enough to cover this page from top to bottom and side to side, including the coloured margin.
This we call a *mask*.
Place it over the frame below this one.
Now write down in your notebook the answer to this question.
Is the coloured margin on the right—
$1\frac{1}{2}$ miles wide? $1\frac{1}{2}$ inches wide?
To find out if you are right, pull down the mask until you can see the answer printed in the margin.

---

2 Mark your answer. Your answer should always be written down before you check it.
This is because we LE – – N better if we try on our own.
Write down the word.
Move down the mask.

1
$1\frac{1}{2}$ INCHES

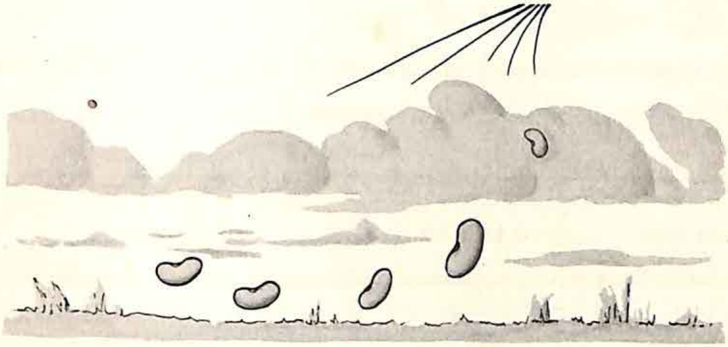
---

3 Check your answer.
Now you know how to use the programme.

2
LEARN

Before you read and answer any question, be sure that the next frames are covered by your mask

1 How much do you notice?
How much can you remember?
Try this game with yourself.



Look at the picture.
How many bean seeds are there?

ANSWER

---

2 What can you see in the shape of the cloud pictured in frame 1—a hill, a tree, a face, or a rainbow?

1
5 OR FIVE

---

3 Which of these is it—
a dwarf, a giant, or an animal?

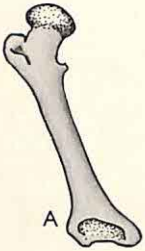
2
A FACE

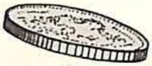
---

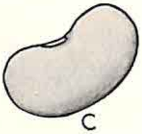
4 *Puss in Boots, Sindbad the Sailor, Jack and the Beanstalk*—which of these three stories has a giant and five bean seeds in it?

3
A GIANT

5 What did the beanstalk grow from—A, B, or C?


A


B


C

4 JACK AND THE BEANSTALK

6 Was the beanstalk strong and tough, or weak and tender?

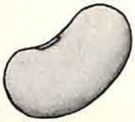
5 C

7 What did Jack do which proved this to be so?

6 STRONG AND TOUGH

8 Jack's beanstalk grew from a magic bean in a fairy story. There are many different kinds of real bean, some nearly as interesting as Jack's. Some climb and some do not; one even jumps! Here are three kinds.

broad bean;
light brown;
does not climb.


scarlet runner bean;
purple with black;
climbs.

French bean;
brown;
does not climb.

Which of these beans do not climb?

7 JACK CLIMBED IT

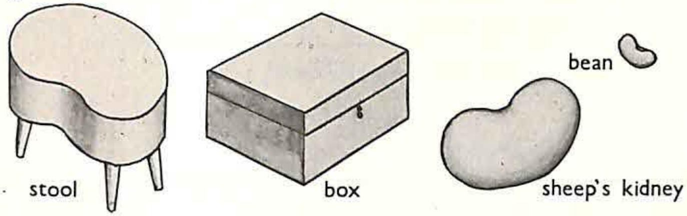
9 Which is the climber?

8 BROAD BEAN; FRENCH BEAN

10 Which seed is purple, but has another colour in its name?

9 SCARLET RUNNER BEAN

11 Which, because of its shape, does not belong to the group?



10 SCARLET RUNNER BEAN

---

12 The stool and the bean have the same shape as the ------.

11 BOX

---

13 The scarlet runner is sometimes called a kidney bean because it is shaped like a ------.

12 KIDNEY OR SHEEP'S KIDNEY

---

14 *Try this experiment.*
Put several scarlet runner bean seeds to soak in water for 24 hours. Keep back a dry one to feel and look at.

13 KIDNEY

---

15 Among the following are two which are living things—say which:
bath, boat, bean seed, bottle, boy.

---

16 Which three of these can grow—
table, boy, car, puppy, seed, diamond?

15 BEAN SEED; BOY

---

17 Which in frame 16 are not living things?

16 BOY, PUPPY, SEED

---

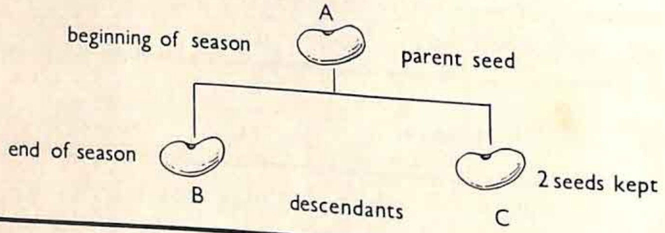
18 Which do not grow?

17 TABLE, CAR, DIAMOND

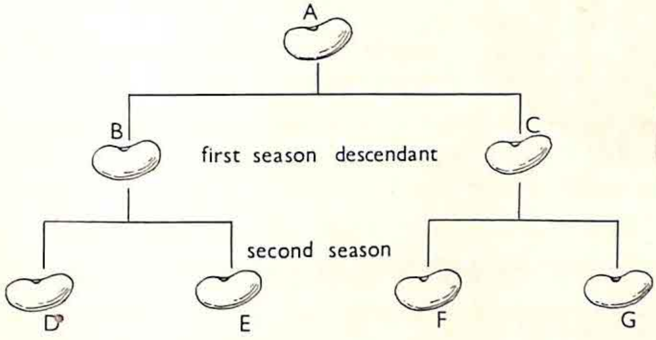
---

19 Which one, because of its nature, does not belong to this group—signal, salt, snail, sugar, silver?

18 TABLE, CAR, DIAMOND

20	Which three of the following are able to grow and produce others like themselves—that is, to REPRODUCE—rabbits, trollies, blue tits, bicycles, bean seeds?	*19* SNAIL
21	Which are not able to grow or reproduce others like themselves?	*20* RABBITS, BLUE TITS, BEAN SEEDS
22	Which of these *cannot* GROW AND REPRODUCE at some time in its life—cat, canary, car, cucumber?	*21* TROLLIES, BICYCLES
23	What in frame 22 is *not* a living thing?	*22* CAR
24	Living things g - - - and r - - - - - - - - themselves. Write the missing words in your notebook.	*23* CAR
25	Monkey, sweet pea, radish, cat, ferret, scarlet runner bean. All these can g - - - and r - - - - - - - - themselves. They are all - - - - - - things.	*24* GROW REPRODUCE
26	Both animals and plants reproduce. We can speak of a PARENT plant when other plants or seeds have come from it. In this drawing, which is the parent bean—A, B, or C?  A beginning of season parent seed end of season B descendants C 2 seeds kept	*25* GROW REPRODUCE LIVING
27	DESCENDANTS come down from the parent. Which are the descendants in the drawing—A and B, B and C, or A and C?	*26* A

28 These descendants can now become parents in their turn. If only two seeds from each were kept, the pattern would be—



How many descendants are shown at the end of the second season?

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27
B AND C

---

29 Which are the parents of D, E, F and G?

28
FOUR OR 4

---

30 If this pattern is continued, two descendants to each parent, how many descendants would there be in the 3rd season?

29
B AND C

---

31 It is likely that the bean you hold is a descendant of one that came from SOUTH AMERICA in 1633. About how many years ago was that?

30
EIGHT OR 8

---

32 Each runner bean can reproduce hundreds of similar ones in a season; they are good to --- at meals.

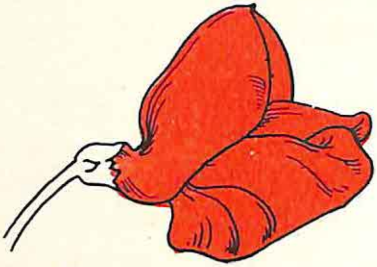
31
ABOUT 330

---

33 But it was not for food that this plant was first brought from S---- A------.

32
EAT

34



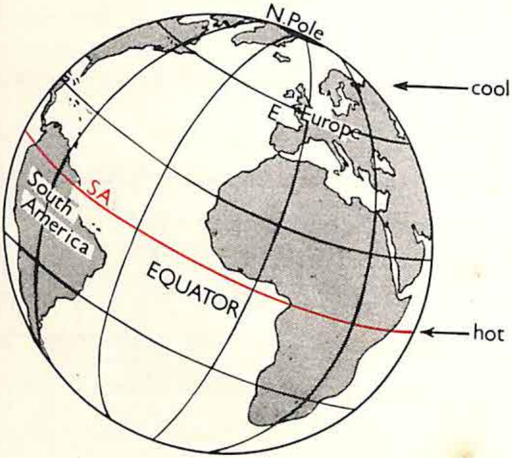
colour
bright scarlet

flower of the scarlet runner

The plant was brought over to Europe for its handsome and decorative flowers.
What colour are the flowers?

33
SOUTH AMERICA

35



Where is it warmer, at SA or E?

34
SCARLET

---

36 Because of this, the scarlet runner grows well only in warm weather. Which part of the year would it grow in England—winter, spring, summer, autumn?

35
SA

---

37 Nowadays we use the young green and tender pods which hold the seeds to eat as a green vegetable. The scarlet runner is therefore a valuable f – – –.

36
SUMMER

---

38 It likes w – – – weather.

37
FOOD

---

39 Spain, England, Norway— in which of these three countries could the earliest planting of runner beans be made?

38
WARM

---

40 Your bean must not be planted outdoors in Britain until the frosts have finished, which is about mid-May The bean is a living thing and f – – – – will kill it.

39
SPAIN

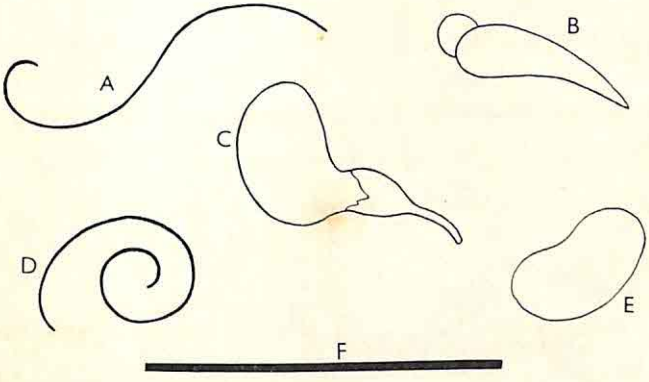
---

41 This scarlet runner bean is sometimes called a k – – – – – bean, because of its shape.

40
FROST

---

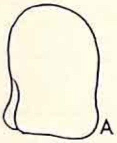
42 The curving flowing lines of the kidney shape are those of a live thing.

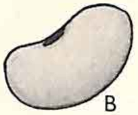


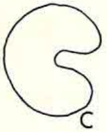
Which is the "dead" line?

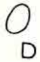
41
KIDNEY

43



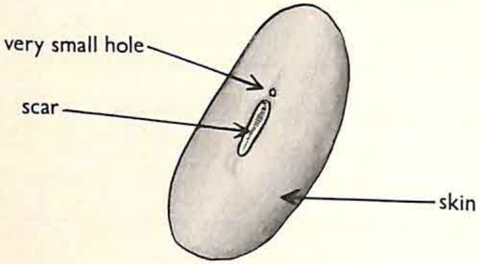






Which is the scarlet runnner or "kidney bean"?

44



Take an actual bean and look at these points:

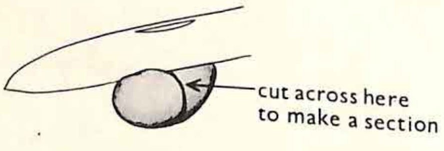
SMALL HOLE —you may need a magnifying glass.
SCAR —hard, cream in colour.
SKIN —smooth, shiny, purple with dark patches.

Cut off a small piece of the skin. What colour is underneath—blue, purple, or cream?

---

45 How does the outer skin feel, and what is its colour?

46



What is in the middle—seeds, a soft part, or a space?

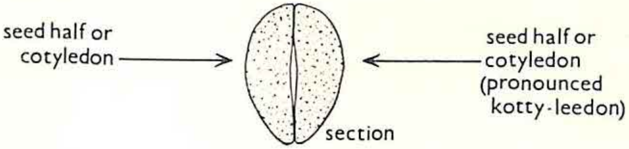
42
F

43
B

44
CREAM

45
SMOOTH,
SHINY;
PURPLE WITH
DARK PATCHES

47



What colour is the cut part?

46
A SPACE

---

48 Now look at your soaked beans (frame 14). Are they smaller, or larger?

47
CREAM

---

49 Is the water coloured or clear?

48
LARGER

---

50 Where has the colour come from?

49
COLOURED

---

51 Take a soaked bean seed and gently squeeze it, looking at the small hole above the scar. What comes out of the hole?

50
THE BEAN SEED OR THE SKIN

---

52 What has gone into the seed?

51
WATER, AND PERHAPS AN AIR BUBBLE

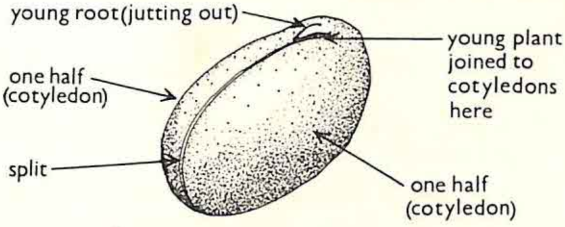
---

53 Look at the cut face (the section) of the dry bean seed. Say how many large parts lie around the middle space. (Look back to frame 47.)

52
WATER

---

54 Now take the skin off a soaked seed and see these two halves.



Does the jutting-out part come at the end or the middle of the scar?

53
TWO OR 2

55 Is the skin shaped to fit the seed?

54
AT THE END

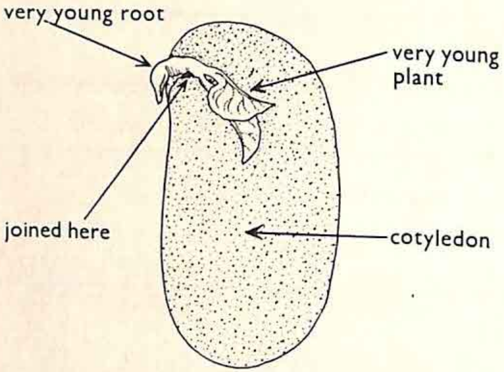
56 Are the two halves joined?

55
YES

57 They are joined near the ---- which is jutting out.

56
YES

58



Now separate the two halves (COTYLEDONS). The very young plant with its root is joined to the cotyledons, so that it can have food while young. In the cotyledons is a store of foods for the ---- ----- -----.

57
ROOT

59 Will the root need food to grow?

58
VERY YOUNG PLANT

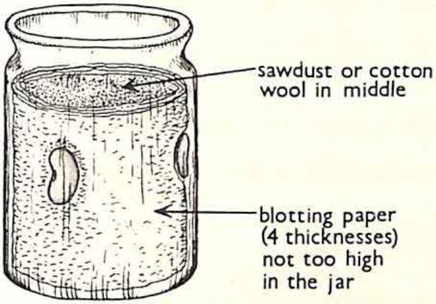
60 Where will the young plant get its food supply from in the first few days of growth?

59
YES

61 The cotyledons not only protect the very young plant, but also are ---- for it.

60
THE COTYLEDONS

62 Arrange two beans in a jam jar with blotting paper and sawdust or cotton wool, as shown in the diagram.


sawdust or cotton wool in middle
blotting paper (4 thicknesses) not too high in the jar

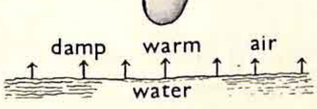
Damp the sawdust or cotton wool thoroughly, and keep it *damp*.
Keep the jar at room heat.
Try putting one jar in the light and another one in the dark. If there is much difference between the contents of the jars after about six days, note this in measurements and with drawings.
You can try putting the beans on a thick block of wood which is floating on water in a jar. In this case, cover the jar with paper.

61
FOOD

---

63 To start seeds growing they must be kept d – – p and w – – m.

64



In the d – – – w – – – air, *above the water*, are the three things the seed needs to begin to show life—to GERMINATE. These are WATER, AIR, and WARMTH.

63
DAMP;
WARM

65 The very young plant will get food from the
– – – – – – – – – –.

64
DAMP;
WARM

---

66 What three things, besides food, will the plant need to start its life, or germinate?

65
COTYLEDONS

---

67 Seeds do not germinate in packets if they are kept in a – – – place.

66
WATER, AIR,
WARMTH

---

68 Why is it so important that seeds in packets should not be stored in a damp warm place? Because they would
– – – – – – – – –.

67
DRY

---

69 When seeds are planted in soil, do they get any light while germinating?

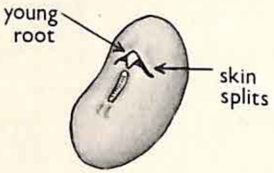
68
GERMINATE

---

70 Must seeds have light for germination?

69
NO

71

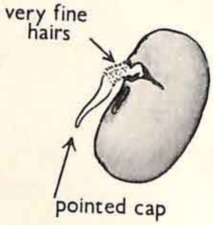


4th day

In a few days the seeds should germinate.
Make drawings of any changes.
First the skin – – – – – –.
The – – – – – – – – – can now be seen.

70
NO

72

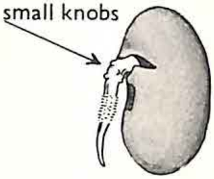


5th day

What has the root now? (You should see two things.)

71
SPLITS;
YOUNG ROOT

73



6th day

The root has grown much longer, and is going – – – – – – – – – – .
(Upwards, downwards, or sideways?)
Small – – – – – are showing between the root hairs and the cotyledons.

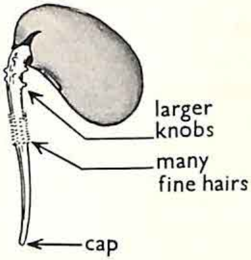
72
FINE HAIRS;
POINTED CAP

---

74 If the bean were in soil, the root hairs would be starting to collect water and food for it. The more root hairs the more – – – – – and – – – – would be collected.

73
DOWNWARDS;
KNOBS

75

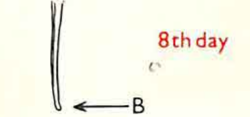


7th day

The knobs are – – – – – – .
The root is growing very quickly at the – – – .
(Where?)

74
WATER;
FOOD

76

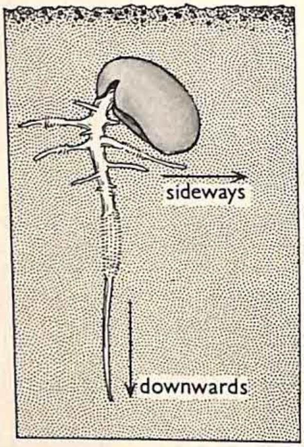


8th day

What have the knobs become?
What are at A?
What is at B?
Which root would collect most food and water for the plant—a small long one with no hairs, or a large branching one with many hairs?

75
LARGER;
CAP

77 Now plant your beans in good rich soil.



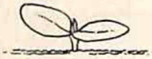
While the first root grows ----------, the side roots grow ---------.

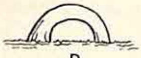
Soon the side roots grow much larger than the first downward-growing root.

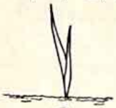
76
SIDE ROOTS;
MANY FINE HAIRS;
CAP;
LARGE BRANCHING ONE WITH MANY HAIRS

---

78 In a few days a shoot will show above ground. The scarlet runner shoot is like an arch, or the top of a shepherd's crook. Which is it—A, B, C, or D?


A


B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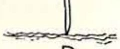
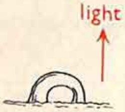
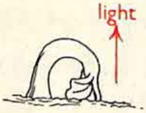
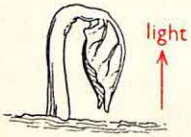

D

77
DOWNWARDS;
SIDEWAYS

79







The crook straightens out and the growing shoot comes upwards into the -----.

78
B

---

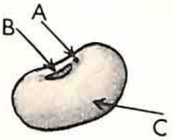
80 In some other bean plants the cotyledons are carried out of the ground by the stem, but the scarlet runner ones stay below, while the root continues to grow, and to take over the work of finding ---- and ----- for the young plant.

79
LIGHT

80
FOOD;

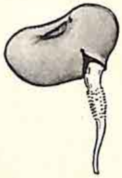
Things to do

1 Draw and paint different kinds of bean seeds.

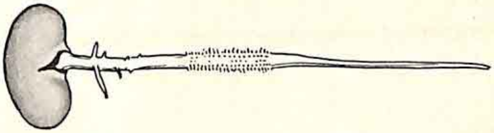
2 

What do the arrows on this diagram point to?

3 What is wrong with this drawing?



4 And with this?



5 What provide food for the young plant before the root grows?

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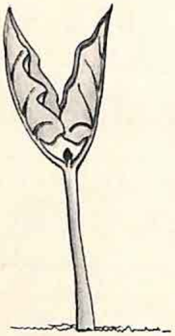
Growth

81 The first shoot is very pale, but as soon as it reaches the light it quickly turns to the usual leaf colour, which is – – – – –.

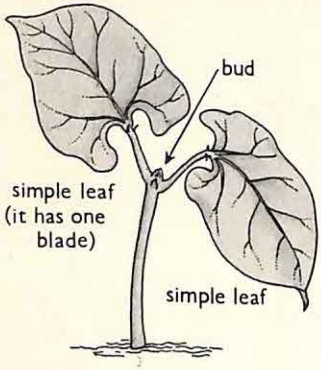
82



Here is a picture of the first leaves showing above ground.
How many are there?
(Do not count the tiny shape between the larger leaves, although actually this is a kind of leaf.)

81
GREEN

83



What is between the leaves?

Keep your beans well watered and in plenty of light.

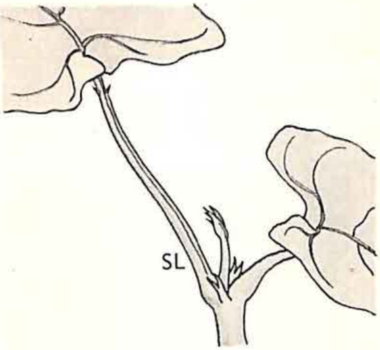
82
TWO OR 2

---

84 The first two leaves of the scarlet runner are s – – – – – leaves. (Look at the drawing in frame 83. Note the shape of the leaves and compare them with living plants if you can.)

83
A BUD

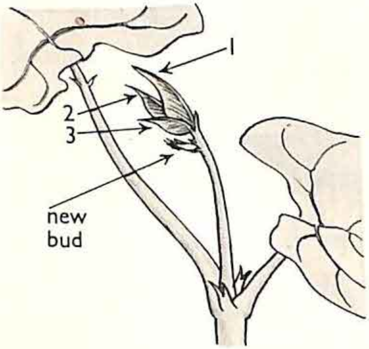
85



Here is the leaf beginning to show in the growing bud.
What kind of leaf is on the stalk marked SL?

84
SIMPLE

86

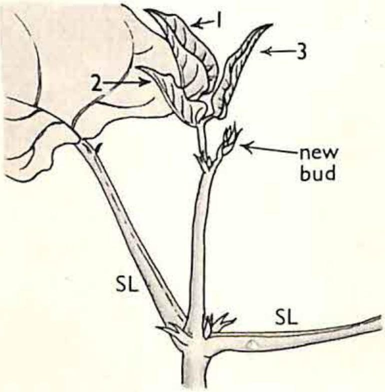


A bud has grown away from the leaf.

How many points has this leaf?

85
SIMPLE

87



A leaf with more than one blade is a COMPOUND LEAF.

What do you call this young leaf with three blades?

86
THREE OR 3

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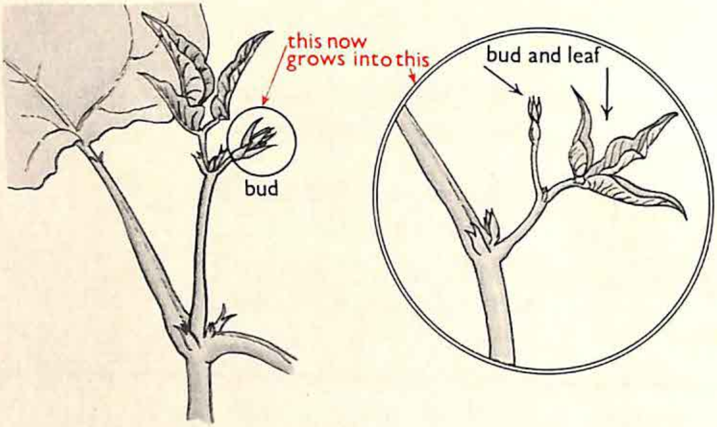
I.C.M.R., W.B. LIBRARY

88

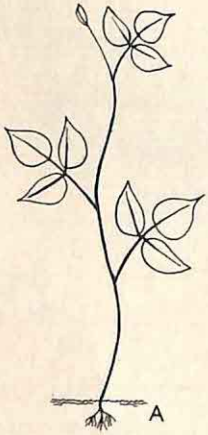


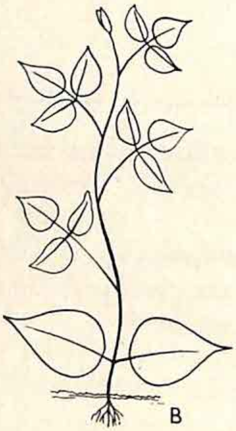
What kind of leaf has grown from this bud—simple or compound?

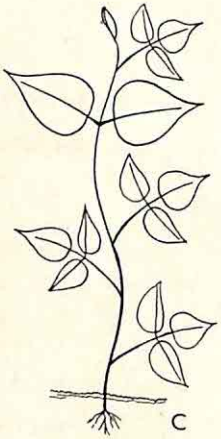
87
COMPOUND
LEAF

89

This bud to leaf-and-bud pattern repeats itself as the plant climbs.







Which one of these simple and compound leaf patterns is like that of the scarlet runner—A, B, or C?

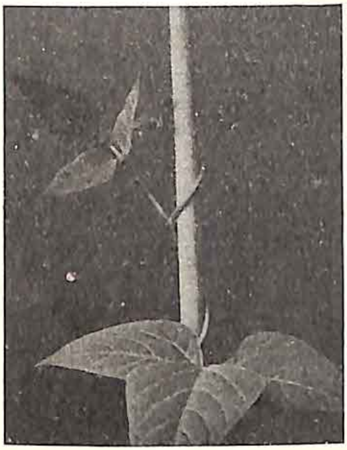
88
COMPOUND

90 Why did you say B?

89
B

---

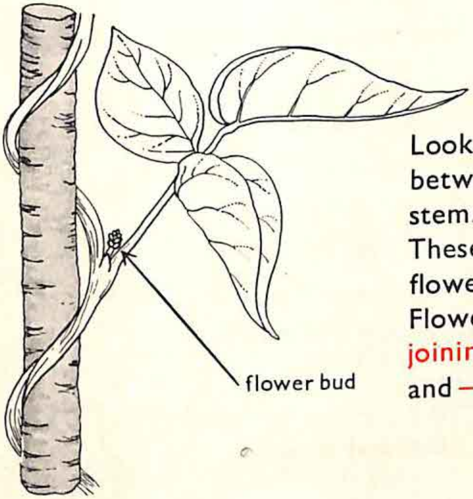
91 Now push some long poles into the ground, and watch your bean climb.



The stem will twine around the pole like this. Is this stem twining clockwise or anti-clockwise?

90
BECAUSE IT HAS TWO SIMPLE LEAVES AT THE BOTTOM AND COMPOUND ONES AS IT GROWS UP

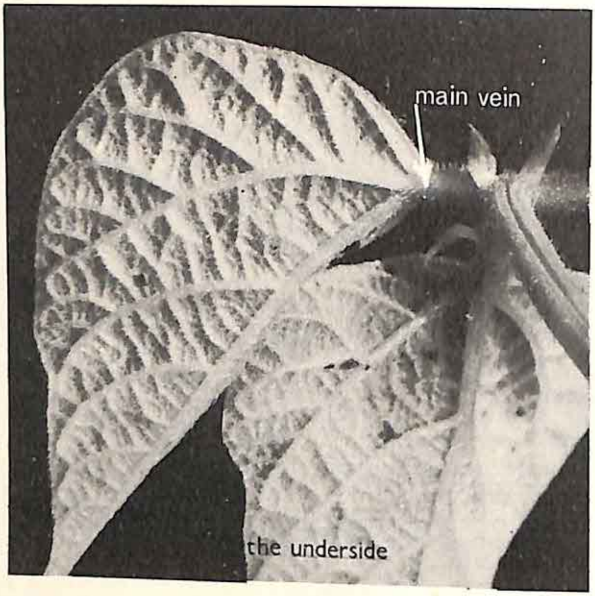
92



Look out for buds between a leaf and the stem.
These will most likely be flower buds.
Flower buds grow in the joining between ---- and ----.

91
ANTI-
CLOCKWISE

93 Now look closely at a leaf, using a magnifying glass if you have one. Where are the veins most easily seen—on the underside or on the topside?



---

94 Start anywhere on the leaf and try to trace a way along the veins to the main vein. Can you do this every time?

---

95 Now start at the main vein and go to any spot on the leaf along veins. Is this also possible?

---

96 Imagine veins to be roads. Could every part of the leaf be served with supplies from the main vein?

---

97 Could collections be made from all parts and taken to the main vein?

---

92 LEAF AND STEM

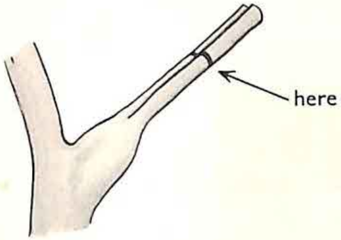
93 THE UNDERSIDE

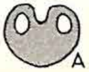
94 YES

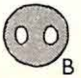
95 YES

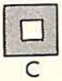
96 YES

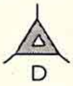
98 Which of these sections, A, B, C, or D, is of a bean leaf stalk cut across?







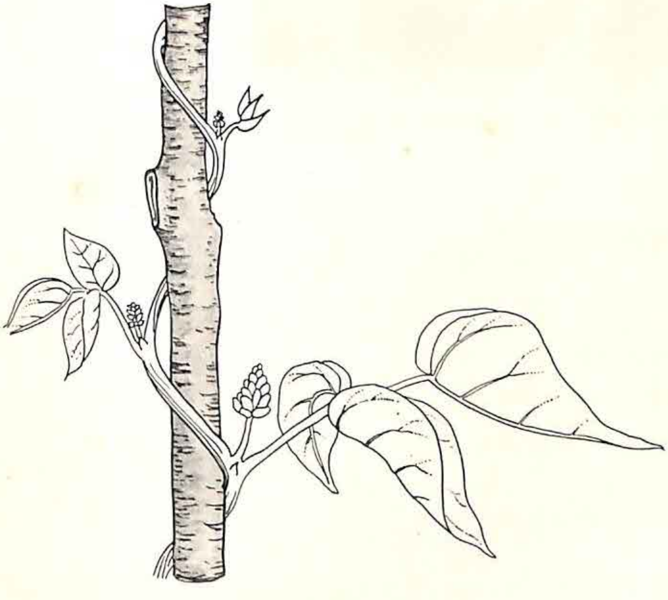




97
YES

---

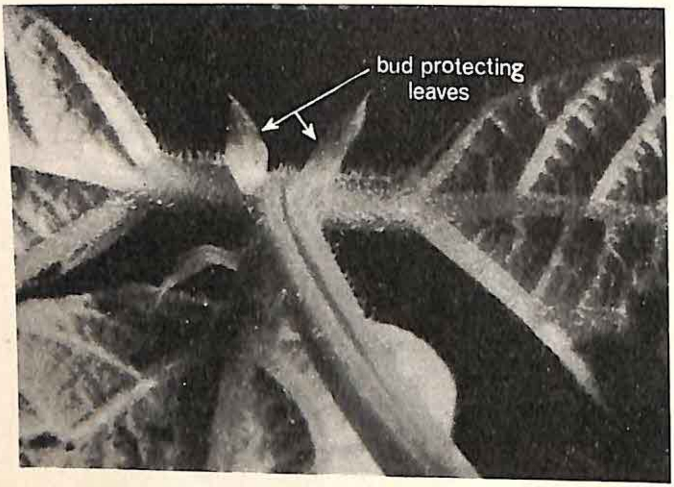
99 Does the leaf wrap itself round the pole or stand out from it?



98
A

100 A young bud is a tender thing and needs protection. The small leaves looking like ears have covered the leaf bud and so p – – – – – – ed it while young.

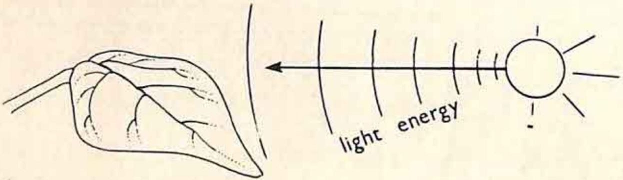
Now they join in the *work* of the leaf.



99
STANDS OUT FROM IT

LEAVES MEAN LIFE FOR US

101

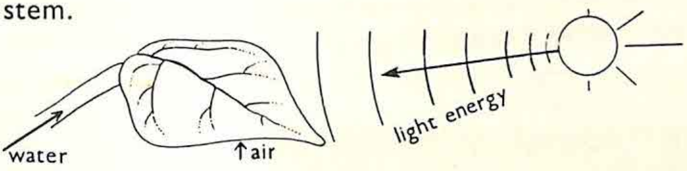


ENERGY from the SUN comes to the leaf as LIGHT.

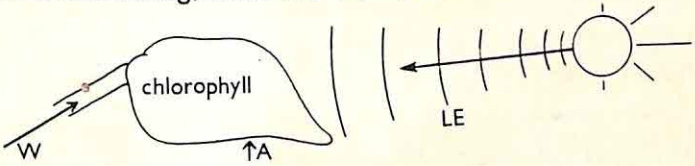
The leaf holds its top side to the rays of l – – – – coming from the sun.

100
PROTECTED

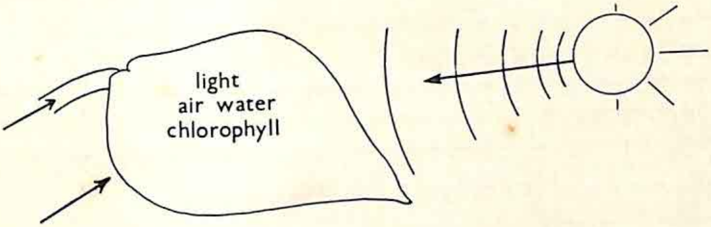
102 The leaf also takes in – – –, and – – – – – flows up the stem.



103 In the leaf is a fluid called CHLOROPHYLL, the same colour as the leaf. What colour is it?
In the drawing, what are W, A, and LE?

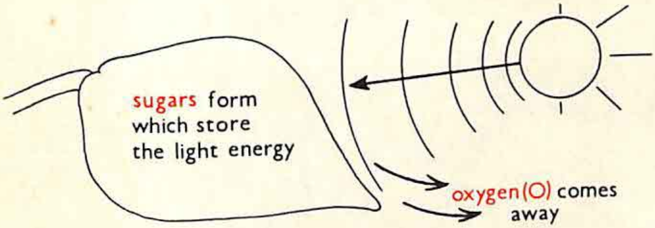


104



What things have come together in the leaf?

105



These four things coming together in the leaf cause SUGARS to form. These are able to *store* the l – – – – e – – – – –.

101
LIGHT

102
AIR;
WATER

103
GREEN;
WATER;
AIR;
LIGHT
ENERGY

104
LIGHT;
AIR;
WATER;
CHLOROPHYLL.

106 What is shown coming out of the leaf?

107 The sugars in the leaf *store* light energy from the – – –.

108 The plant itself needs some of these sugars to live, grow, and reproduce. What it does not need it st – – – s for use when required.

109 The roots get their energy from the sugars formed in the l – – – – s of the plant.

110 The climbing, twisting and twining stem also gets its energy from the sugars in the – – – – – –.

111 In a motor car, what stores the electric energy to start the car and light the lamps?

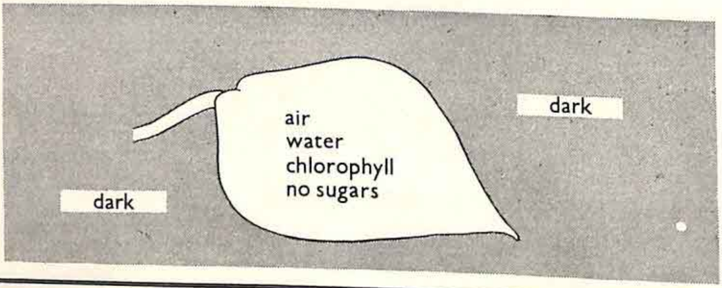
112 In a plant, what substances store energy?

113 Where are these first formed?

114 They pass from the – – – – – s to other parts of the plant.

115 What four things come together to form sugars?

116 In this leaf, no sugars are being formed and no oxygen is coming away. Why?



105
LIGHT ENERGY

106
O OR OXYGEN

107
SUN

108
STORES

109
LEAVES

110
LEAVES

111
A BATTERY

112
SUGARS

113
IN THE LEAVES

114
LEAVES

115
LIGHT;
AIR;
WATER;
CHLOROPHYLL

117 Sugars in a leaf, and the battery in a car, both store e – – – – –.

116
BECAUSE IT IS IN DARKNESS

---

118 Sugars form in the leaf only in the – – – – – and not in the dark.

117
ENERGY

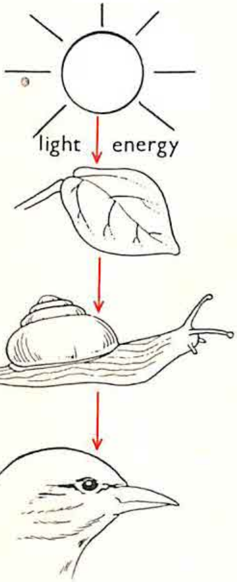
---

119 Animals can now use these sugars as food and so get e – – – – – to live.

118
LIGHT

---

120 Here is an energy food chain.



Light energy comes from the – – –.

119
ENERGY

121 Sugars form in the leaf and store this e – – – – – from the sun.

120
SUN

122 The snail gets its energy by eating the – – – –.

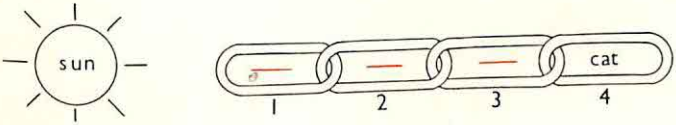
121
ENERGY

123 The bird gets its energy by eating the – – – – –.

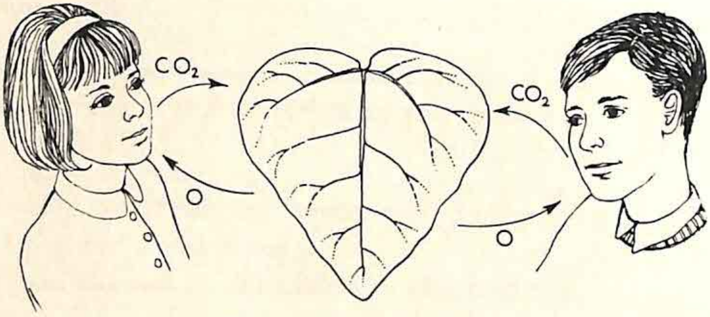
122
LEAF

---

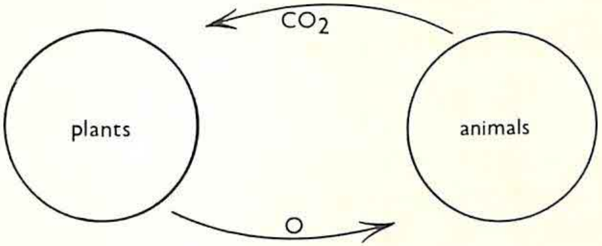
124 Suppose a cat ate the bird. Now fill in the links of the energy chain, back to the sun.



123
SNAIL

125	The leaf is the first – – – – in the chain, giving animals their – – – – – – storing foods.	124 1 = LEAF 2 = SNAIL 3 = BIRD
126	When sugars form, what gas comes away from the leaf? (Look back to frame 105.)	125 LINK; ENERGY
127	In the country there are more l – – – –s than in the town.	126 OXYGEN
128	Therefore country air has more o – – – – – in it than town air has.	127 LEAVES
129	*All animals and people need oxygen* in the air, and – – – – –s give it.	128 OXYGEN
130	What goes from the leaf to the children?  CO_2 is CARBON DIOXIDE	129 LEAVES
131	What goes from the children to the leaf?	130 OXYGEN
132	This CO_2 is a very small part of the air, but it is needed for the forming of sugars in the – – – – – –.	131 CO_2 OR CARBON DIOXIDE

133



So there is a balance between plant and animal life. The o – – – – – given off by plants is taken up by – – – – – – – –.

132
LEAVES

---

134 The CO_2 given off by animals is taken up by – – – – – –.

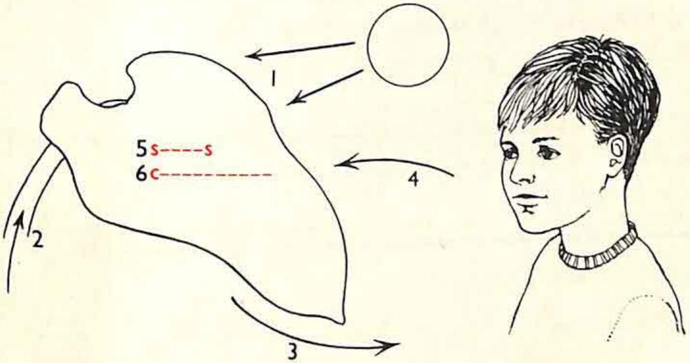
133
OXYGEN;
ANIMALS

---

135 As our bodies are part of the animal world, LEAVES MEAN – – – – FOR US ALL.

134
PLANTS OR
LEAVES

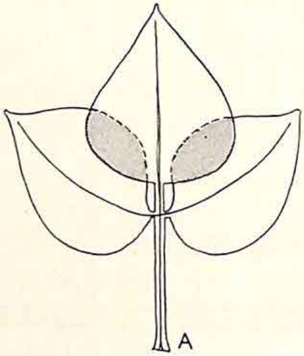
136

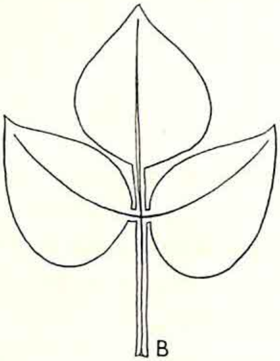


What do all the numbers mean? Write down the answers in your notebook.

135
LIFE

137 In the bean leaf you can see how a living thing can fit itself for its work.





Which will have more light—A or B?

136
1 ENERGY OR LIGHT
2 WATER
3 OXYGEN OR O
4 CARBON DIOXIDE OR CO_2
5 SUGARS
6 CHLOROPHYLL

---

138 Which is more like the bean leaf—A or B?

137
B

---

139 Living things are able to fit themselves to what is around them. We say that they ADAPT themselves to conditions. What two other things do living objects do?

138
B

---

140 Growing flowers is the next stage in the life of the bean. It is here that seeds begin to be formed and the bean begins to r – – – – – – – – itself.

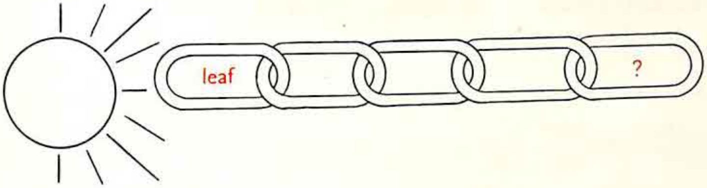
139
GROW; REPRODUCE

Now try to answer the following questions. Look up the answers if you have forgotten.

140
REPRODUCE

Test 1

1 How many simple leaves grow on one bean plant?
2 How many blades has a compound bean leaf?
3 Which way does the stem twine—clockwise or anti-clockwise?
4 What do the very small leaves, sticking up like ears, do (*a*) for the unopened buds? and (*b*) for the plant after this work is done?
5 Where does light energy start from?
6 What forms in the leaf in light?
7

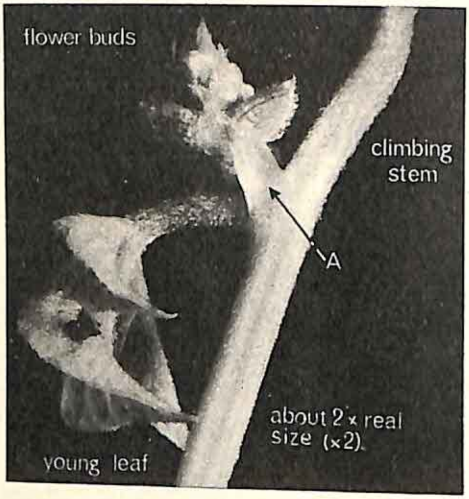


Fill in possible links in this energy chain.
Try to put in another link.

8 What gas, given off by plants, is needed by animals?
9 What gas, given off by animals, is needed by plants?
10 What else can a living thing do besides grow and reproduce?

141

Flowers



What is at A?

---

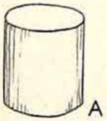
142 Flower stalks grow from the joining between l – – – and s – – –.
(Look back to frame 92.)

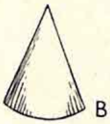
---

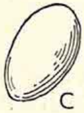
143 What kind of leaf is shown in frame 141—simple or compound?

---

144 Which of these shapes is most nearly like the group of flower buds—A, B, or C?


A


B

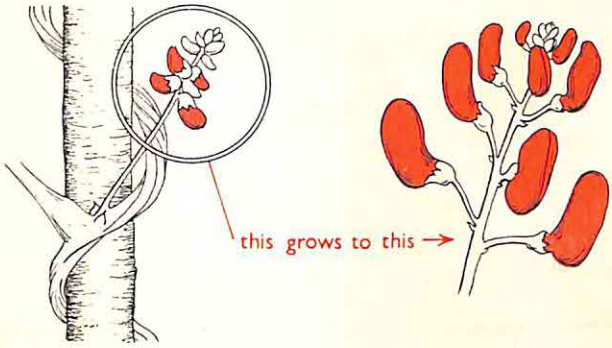

C

141
A BUD PROTECTING LEAF, OR A VERY SMALL LEAF

142
LEAF; STEM

143
COMPOUND

145



Where are the smallest buds—top, middle, or bottom?

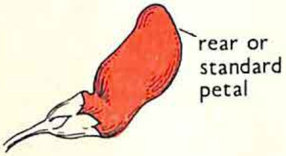
144
B

---

146 What colour are the flowers?

145
TOP

147



Each flower is a neatly folded parcel. The s - - - - - - - petal is wrapped around the others.

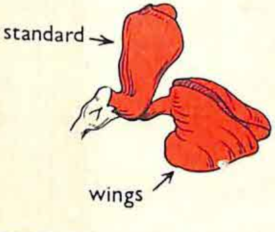
146
SCARLET

---

148 About how many single flowers are there on a stalk?

147
STANDARD

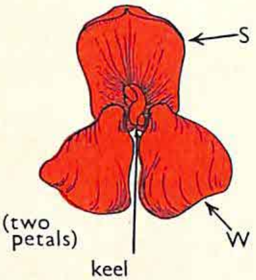
149



As the flower opens two petals appear which look like the - - - - - of a butterfly.

148
TWELVE TO EIGHTEEN (12 TO 18)

150



Look at the flower from the *front*.
Two more petals, tightly twisted, make the ---- of the flower.

149
WINGS

---

151 What is the lowest part of a boat called?

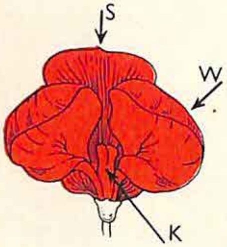
150
KEEL

---

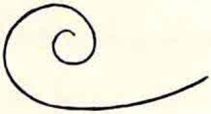
152 In the drawing in frame 150, what are S and W?

151
THE KEEL

153



Look at the flower from below.
The two k--- petals cover a spiral-shaped part—the STYLE.



A spiral shape

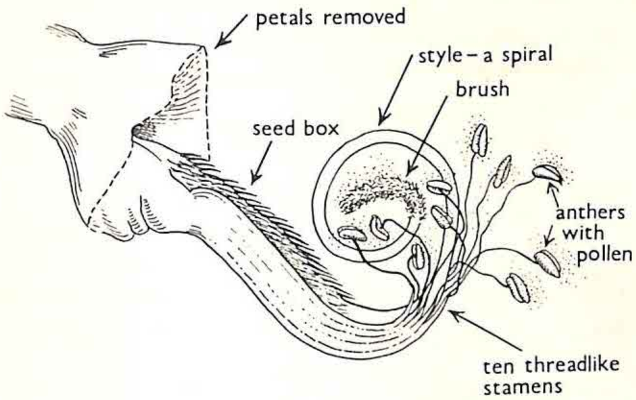
152
STANDARD;
WINGS

---

154 How many petals has one flower?

153
KEEL

155



Look very carefully at the picture.
What is on the curved end of the style?

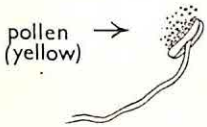
156 What is on the other end?

157 What ten things are wrapped around the style?

158 What is at the free end of each stamen?

159 How many anthers are there?

160



A yellow dust forms on the anthers. It is p – – – – –.

161 This pollen is very much alive, and if it leaves the anthers and gets on to the end of the brush *it will begin to grow* rapidly.
It looks like yellow – – – –.

154 FIVE OR 5

155 A BRUSH

156 A SEED BOX

157 STAMENS

158 AN ANTHER

159 TEN OR 10

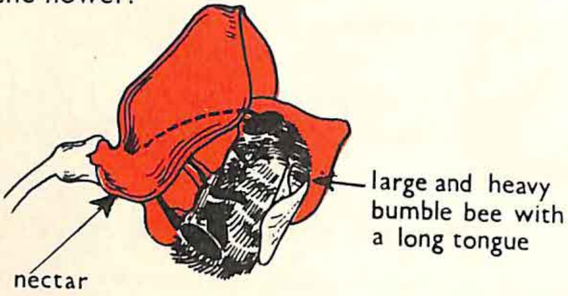
160 POLLEN

162 It is so small that it will float on the wind, and insects can carry it from flower to f – – – – –.

161
DUST

---

163 Bees visit flowers for NECTAR, a sweet drink deep inside the flower.



The bee getting the nectar from the flower is a – – – – – – bee.

162
FLOWER

---

164 To get the nectar it has to push its long hairy tongue between the keel petals into the part holding the n – – – – –.

163
BUMBLE

---

165 The heavy weight of the large – – – – – – bee causes the brush on the s – – – – to pop out and so dust the bee with pollen.

164
NECTAR

---

166 This p – – – – – is then carried to another flower.

165
BUMBLE;
STYLE

---

167 As the style b– – – – of the next flower pops out, the end of it touches the bee, which in this way gets pollen from another flower. At the same time it dusts the bee with its own pollen.

166
POLLEN

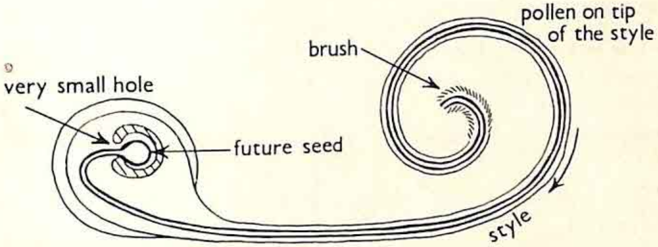
168 Only the bumble bee can work the scarlet runner flower properly, but after its visit other insects can get at the ------, through the hole which the bumble bee has made.

167 BRUSH

169 In the case of this bean it is not really necessary for an insect to carry ------. The flower can use its own pollen, and often does.

168 NECTAR

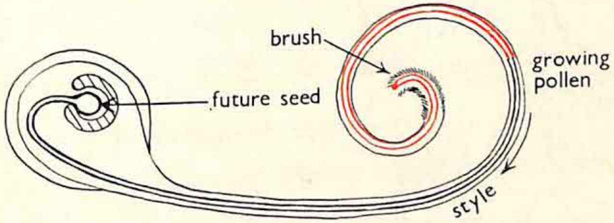
170



This is the position after pollen has found its way on to the b---- end of the spiral s----.

169 POLLEN

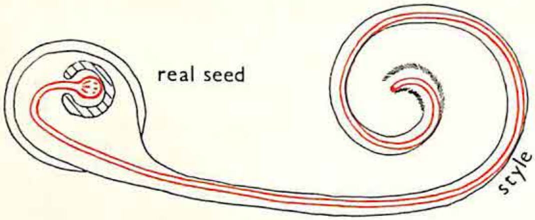
171



Now the speck of pollen grows very quickly and passes down the ----- to the future seed.

170 BRUSH; STYLE

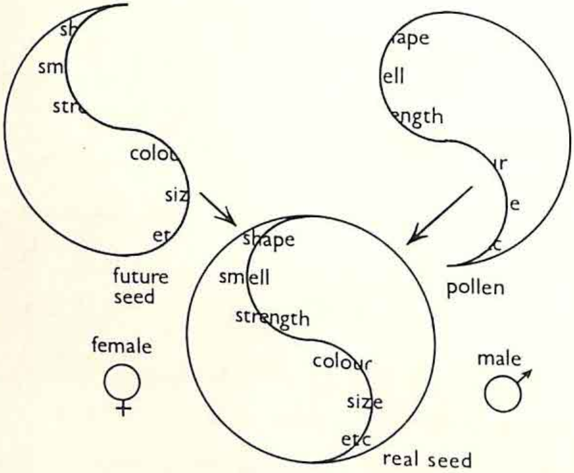
172



The pollen tube reaches the future seed and becomes one with it. The pollen and the future seed together form a – – – –seed.

171
STYLE

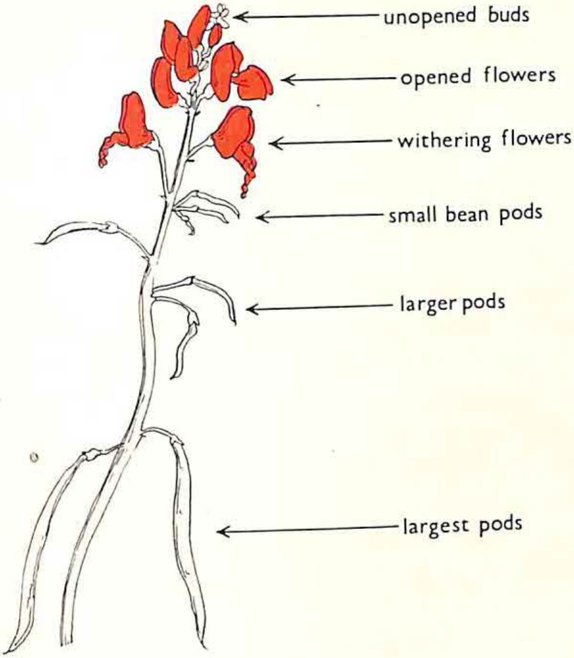
173



In the real seed lies the pattern for a new plant, formed by the coming together of the pollen and future seed. Name five things which might show one plant to be different from any other.

172
REAL

174



What are at the top of the flower stalk?

175 These buds will grow into opened ‒ ‒ ‒ ‒ ‒ ‒ ‒.

176 When real seeds have been formed (FERTILIZED) the flowers will w ‒ ‒ ‒ ‒ ‒.

177 These withered flowers become small bean p ‒ ‒ s.

178 These become l ‒ ‒ ‒ ‒ pods.

179 What are at the bottom of the flower stalk?

180 These pods are the FRUIT of the flowers.

173
SHAPE,
STRENGTH,
SMELL, SIZE,
TASTE, FEEL,
COLOUR, HABIT
OF GROWTH,
AND OTHERS

174
UNOPENED
BUDS

175
FLOWERS

176
WITHER

177
PODS

178
LARGE

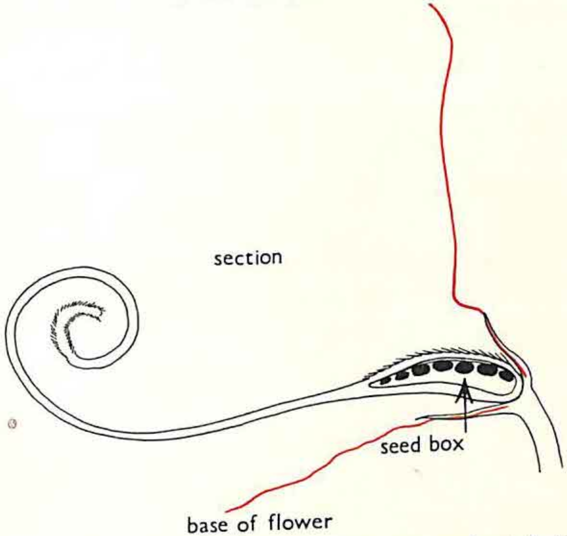
179
LARGEST PODS

Test 2

1 Where do flower stalks grow from?
2 Where are the smallest buds—at the top, middle, or bottom of the plant?
3 Which petal is wrapped round the others?
4 Which petals make the flower look like a butterfly?
5 How many petals make up the keel?
6 Draw the shape of the style.
7 How many petals has one flower?
8 How many stamens and anthers has one flower?
9 What forms on the anthers?
10 What kind of bee can work the bean flower?
11 What does the pollen begin to do when it gets on the end of the style?
12 When the pollen reaches the future seed, what does this seed become?

The Fruit

181



The seed box is now a very small bean pod with tiny beans. How many beans can you see?

182 Through the style the ------ has come to make the future seeds into ---- seeds.

181 SEVEN OR 7

183 All parts of the flower except the SEED BOX, or POD, now w------ away.

182 POLLEN: REAL

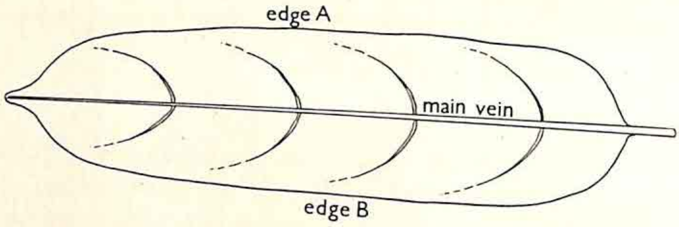
184 Only the --- with its s---s is left to grow.

183 WITHER

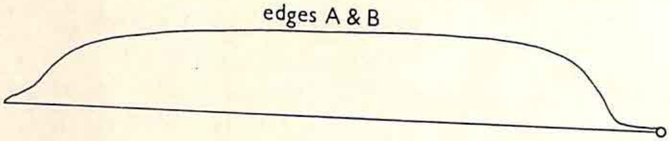
185 The pod is another special kind of leaf with a very special job to do. It protects and feeds the young ----s and grows with them.

184 POD: SEEDS

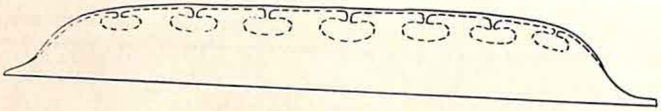
186



Trace this leaf shape on paper and cut it out. Fold it along the main vein so that the edges A and B come together.



You now have roughly this shape.



Are the seeds along the edges, or on the main vein?

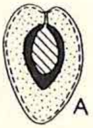
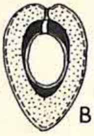
185
SEEDS OR BEANS

---

187 Young pods, with their juicy fleshy coat which protects and ----s the young ----s in it, are very good to eat.

186
ALONG THE EDGES

---

188 Cut a pod through in several places, and you will see this,  or perhaps this. 

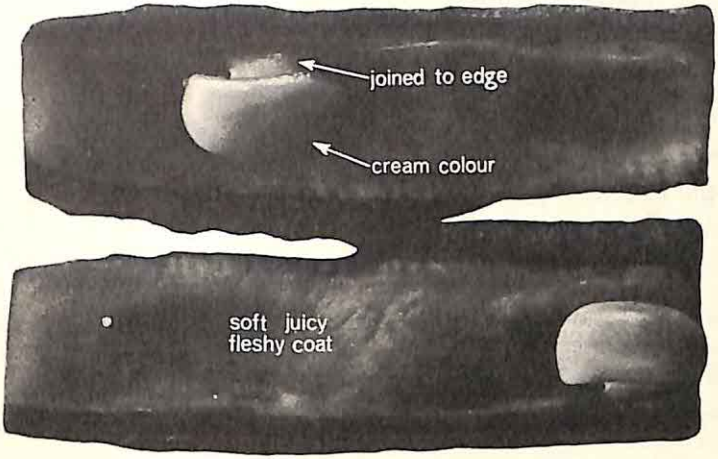
Which drawing, A or B, shows where the cut was between the beans?

187
FEEDS; SEEDS (OR BEANS)

189 The young seeds are joined to the – – – – s of the pod.

188
A

190 Now cut a pod along the edges and open it out.



189
EDGES

191 The soft, juicy and fleshy coat p – – – – – – s and
f – – – s the young bean.

192 Which part of the young bean is attached to the edge—
the skin, or the scar?

191
PROTECTS;
FEEDS

193 What colour are these young beans?

192
THE SCAR

194 People eat bean pods when they are young, because they
are s – – –, j – – – – and tender.

193
CREAM

195 They are sometimes called vegetables, but in fact they are
the FRUIT of the bean plant, because they grow from
the – – – – – – s.

194
SOFT;
JUICY

196 If you wish to save seeds to sow for next year, you must leave some of the pods to ripen and grow further. As they ripen they grow, change colour, and become tough. How many seeds would you have from seven pods if there were seven seeds in each pod?

195
FLOWERS

---

197 Brown, light green, dark green—put these colours in the order they would come on the ripening pods.

196
$7 \times 7 = 49$

---

198 Which would be the toughest pod—a light green, a dark green, or a brown one?

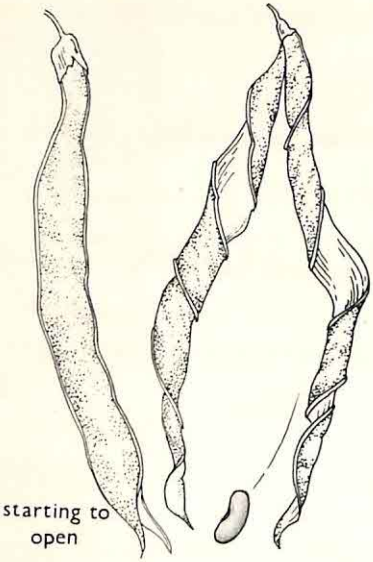
197
LIGHT GREEN,
DARK GREEN,
BROWN

---

199 Which would be the most tender?

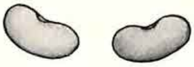
198
BROWN

200



As the pod dries and toughens, the two halves open and twist.

Out come the – – – – s.



199
LIGHT GREEN

201 Suppose that, from one bean, you grew a plant which had twelve flower stalks, and on each stalk twelve pods ripened with seven seeds in each. How many seeds would you have from the one you first planted?

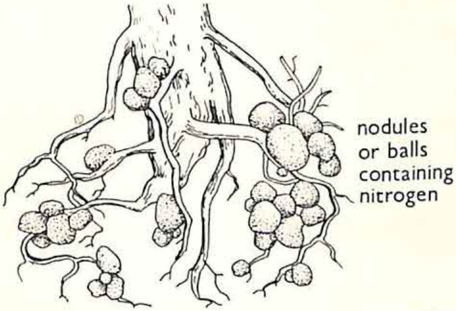
200
SEEDS (OR BEANS)

---

202 Roots are sometimes kept and grown again, but they have to be dug up and stored during the winter, away from c – – – and f – – – –.

201
12 × 12 × 7 = 1,008

203


nodules or balls containing nitrogen

If you dig up the roots you will find some swollen parts looking like small balls. These contain much n – – – – – – –, which is a very good thing to have in the soil.

202
COLD AND FROST

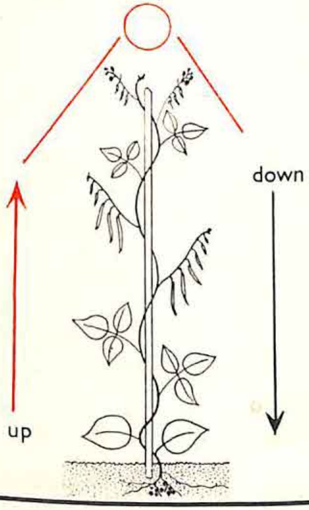
---

204 N – – – – – – – makes a good rich soil.

203
NITROGEN

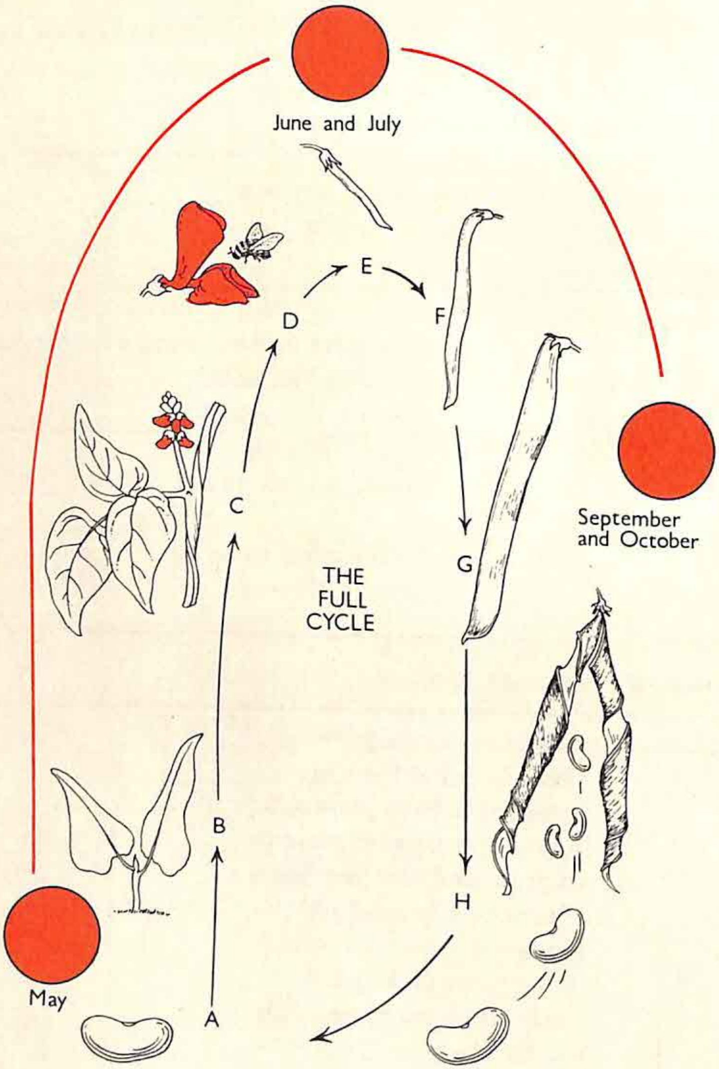
---

205 While the parts above ground have been growing,

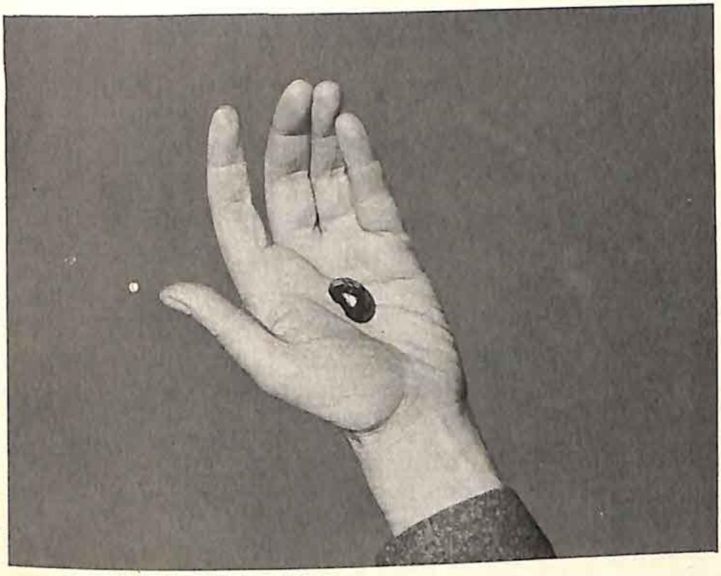


flowering and fruiting, substances have gone *down* to the roots to help them to grow and do their work. Meanwhile food and moisture have been taken in from the soil by the roots and have gone *up* to the parts above ground. The parts above ground have helped the r – – – s, while the roots have helped the p – – – s a – – – – g – – – – –.

204
NITROGEN



Start at A, follow the arrows, and say what stage is shown in the picture by each letter. Write the answers in your notebook.



The seeds now wait for sun, rain, earth, air, the bees and you to give them their chance to grow into new scarlet runners.

206

A BEAN SEED
B FIRST LEAVES (SIMPLE)
C COMPOUND LEAF AND FLOWER STALK
D FLOWER AND BEE
E YOUNG FRUIT
F OLDER POD
G GROWN POD
H SHEDDING BEANS

Test 3

1 On account of its shape, what is another name for the scarlet runner bean?

2 What very important things can a living thing do which make it different from a non-living object? Name as many differences as you can.

3 From where was the scarlet runner brought into Europe?

4 What kind of weather is most suitable for it?

5 What are the colours of the skin of the bean seed?

6 How many cotyledons make up the complete seed?

7 What do they do for the young plant before the root grows large enough to do its work?

8 What is the first sign of germination?

9 What is the shape of the first appearance of the growing shoot of the scarlet runner above ground? Draw it.

10 What kind of leaves are the first leaves—single-bladed ones (simple), or three-bladed ones (compound)?

11 As the stem climbs, what does it do to hold on to a support?

12 Which way does it twine—clockwise or anti-clockwise?

13 Fill in possible links missing from this energy-food chain: Sun, ———, ———, ———, cat.

14 What gas comes from leaves which are in the light?

15 What gas is taken in and used by them?

16 Where does light energy start from?

17 What colour are the flowers of the plant?

18 Where are the smallest buds—top, middle, or bottom of the flower stalk?

19 How many petals make up one flower?

20 Name some of them.

21 What is the shape of the style? Draw or name it.

22 What substance grows on the anthers?

23 Which insect is most successful in working the scarlet runner flower?

24 When pollen is on the tip of the style, what does it then begin to do?

25 When the pollen reaches the future seed, what kind of seed does this become?

26 The fruit of the scarlet runner is the bean – – –.

27 Where are the largest pods on a flower stalk—top, middle, or bottom?

28 What does the soft and juicy coat around the young seeds do for them?

29 When pods dry and toughen, what happens to the seeds?

30 What appear on the roots at the end of the season?

Answers to Tests

Things to do (following frame 80)

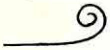
2 A = a very small hole,
B = a scar,
C = the skin.
3 The root is coming out of the seed at the wrong place.
4 The root is growing sideways instead of downwards.
5 Cotyledons or seed halves.

Test 1

1 2 or two.
2 3 or three.
3 Anti-clockwise.
4 a Protect them,
b Work as leaves.
5 The sun.
6 Sugars.
7 *Second link:* anything which eats leaves and which might itself be eaten, such as a snail, a caterpillar, a rabbit.
Third link: anything which might eat something in the second link, such as a bird, a hedgehog, any insect eater.
Fourth link: anything which might eat something in the third link, such as a cat, a weasel, or a stoat.
Fifth link: anything which might prey upon something in the fourth link, such as an eagle, or, more commonly, ticks or fleas.
8 Oxygen.
9 Carbon dioxide.
10 Fit itself to what is around it, or adapt itself to its conditions.

Test 2

1 Where leaf stalk and climbing stem join.
2 At the top.
3 The standard.
4 The wings.
5 2 or two.
6



7 5 or five.
8 10 or ten.
9 Pollen.
10 Bumble bee.
11 Grow.
12 A real seed.

Test 3

1 Kidney.
2 Grow; reproduce; adapt itself to conditions.
3 South America.
4 Summer weather, warm and moist.
5 Purple with dark patches.
6 Two.
7 Protect and feed it.
8 The skin splits.
9 An arch or crook.
10 Simple or single-bladed ones.
11 It twists and twines.
12 Anti-clockwise (looked at from above).
13 Leaf, snail, bird.
14 Oxygen.
15 Carbon dioxide.

16 The sun.
17 Scarlet.
18 Top.
19 Five.
20 Standard, wings, keel.
21 Spiral.
22 Pollen.
23 Bumble bee.
24 Grows and passes down to the future seed.
25 A real seed.
26 Pod.
27 Bottom.
28 Protect and feed them.
29 They fall out.
30 Balls containing nitrogen.

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